

# Carbon footprint estimation - a model for the evaluation of potential climate change impacts of new product ideas in early project stages

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**Abstract** The Carbon Footprint Estimation (CFE)<sup>1</sup> model has been developed by Evonik as a standardized method to evaluate research ideas in terms of climate change impacts. The CFE model facilitates the quantification of potential greenhouse gas burdens, emissions and savings in all phases of product systems. It is an approach to support innovation processes with meaningful sustainability assessments, even in the early stages when uncertainty is still high.

## 1 Introduction

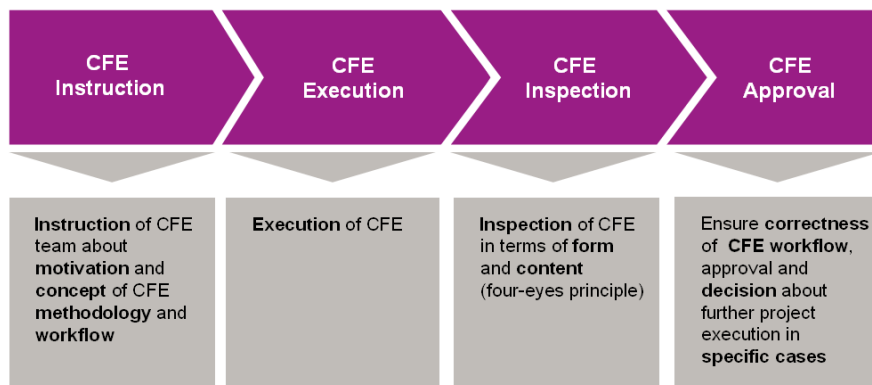
Products with lower climate change impact may offer good prospects of opening new markets, but innovation and research projects aiming to reduce greenhouse gas emissions are not always readily accepted. To make sound decisions even in the early stages of the innovation management process, the evaluation of profitability and practicability is essential, but it should also be complemented with additional sustainability assessments. Such examples are estimates of future greenhouse gas emission savings. However, due to the lack of reliable information in the early stages of R&D projects, it is challenging to create comprehensive Life Cycle Assessments (LCA). Therefore, Evonik has developed the Carbon Footprint Estimation (CFE) model as a standardized method to evaluate research ideas in early project stages. The CFE model facilitates the quantification of potential greenhouse gas burdens, emissions and savings in all phases of product systems.

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## 2 CFE application process

Common reasons for incomplete or incorrect calculation of greenhouse gas emissions in the early project stages are data gaps, poor data quality and the selection of unsuitable calculation methods. In an attempt to minimize these risks, the CFE application and quality assurance process has been structured into four parts – from “CFE Instruction” to “CFE Approval” (Fig.1).



**Fig.1: CFE application and quality assurance process including workflow, roles and responsibilities**

The CFE team consists of an instructor, practitioners, an inspector and a supervisor. It is required that at least two practitioners work together on the CFE - one LCA team member and one member of the project group for whom the CFE is performed. The inspector must be an experienced LCA team member and cannot also be a practitioner. The supervisor ensures an accurate workflow and grants the final approval of the CFE. The supervisor must be a person or consist of a board with the necessary authority to deploy the CFE results (e.g. for internal or marketing purposes).

## 3 CFE approach

The CFE model is a standardized method to quantify the potential CO<sub>2eq</sub> impacts of projects in early stages of development. It is particularly suited for R&D projects at Evonik to guarantee a common procedure, which can comprehensively compare such projects.

Compared to a full LCA, the CFE methodology is limited to the evaluation of the carbon footprint and other global warming impacts. In this respect, all items defined by the goal and scope such as the system boundaries or functional unit must be independently set in addition to the LCA approach. In the subsequent steps, all processes and flows (like raw materials and transports, energy use, production process, product use and end-of-life) are determined for their inputs and outputs (cradle-to-grave). In the early project stages there is however often a lack of information due to several unknowns such as processes, materials, production site, etc.. In these cases, three main risks arise:

- Risk of incomplete data
- Risk of poor data quality
- Risk of unconventional calculation approach

To cope with these risks, a separate handling procedure for each risk category has been created. The risk of incomplete data is handled by, for instance, setting a preference for the use of certain data sources. For the CFE Practitioner, the preferred data source choice is the GaBi 4 professional database<sup>2</sup>. If the desired process is not part of this database and no other data is available, the practitioner is advised to use other data sources and even other comparable processes. If neither process data nor similar process data is available at all, a labelled "worst case" calculation for the carbon emissions is to be performed.

The use of conservative estimations and the mandatory use of sensitivity analyses for certain assumptions (e.g. lifetime of a product) are two examples to deal with the risk of poor data quality.

The risk of incorrect results can arise when employing weak or unconventional calculation methods. An example to manage the risk of a well thought out but unattested calculation approach can be to rely on established product category rules (e.g. within the industry, the lifetime/distance of a passenger car is set at 150 000km or the daily operating time of a notebook is set at 8 hours).

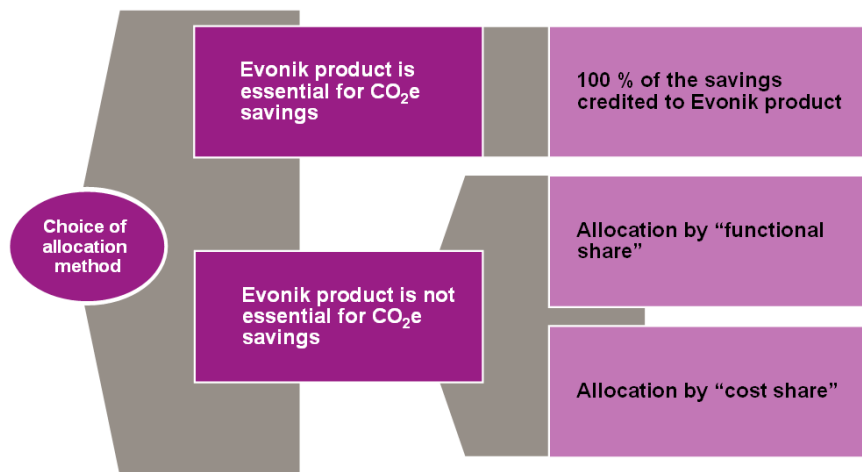
Furthermore, the CFE approach provides assistance in calculating a wide range of emission savings when applying Evonik products compared to existing

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[2] GaBi 4 Software-System and Databases for Life Cycle Engineering by PE International, Leinfelden-Echterdingen, Germany and LBP, Chair of Building Physics, University of Stuttgart, Germany, Copyright TM, Stuttgart, Echterdingen 1992-2008

alternatives. In these cases, the methodology states that the alternative must be an established technology on the market. This precondition essentially limits emission savings to product applications which are new and innovative. Savings can no longer be accredited to a product application once it has become the accepted market standard (e.g. superabsorbent polymers for swaddlers).

Another important aspect of the CFE methodology is the allocation of an appropriate share of emission savings during the in-use phase of product applications which are manufactured by Evonik customers further down the value-added chain. Two principles to allocate savings to the Evonik product application are possible (as shown in Fig.2).



**Fig.2: Allocation principles for emission savings of Evonik product applications**

If the Evonik product is absolutely essential to generate CO<sub>2eq</sub> savings, 100% of the savings are accredited to this product, hence an "enabler". If the Evonik product is not (or not exclusively) essential for the CO<sub>2eq</sub> savings, the savings are allocated by either a functional or a cost share approach. Both calculation approaches are acceptable when accompanied with clear and reasonable justification.

Once communication of the CFE results is desired, the direct comparison of the Evonik product emissions (w/o in-use phase emissions) with the savings during the in-use phase of the product application (which is produced downstream by Evonik customers) should be avoided, as two different scopes would be regarded and compared in this case.

## 4 Evaluation of uncertainties

The quality of the estimated results is measured by the degree of uncertainties as listed in the following three categories (Fig 3):

Data completeness	Data quality	Calculation method
<ul style="list-style-type: none"><li>Classification of data completeness</li><li>0 % No data available</li><li>25 %</li><li>50 %</li><li>75 %</li><li>100 % All data available</li></ul>	<ul style="list-style-type: none"><li>Classification of data quality</li><li>0 % Bad data quality</li><li>25 %</li><li>50 %</li><li>75 %</li><li>100 % Best data quality</li></ul>	<ul style="list-style-type: none"><li>Classification of calculation method quality</li><li>0 % No standardized and established calculation method</li><li>25 %</li><li>50 %</li><li>75 %</li><li>100 % Approved calculation method</li></ul>

**Fig.3: Uncertainties of the CFE approach in three categories**

The "Data Completeness" of all used CFE data is measured in five levels (from 0%: No data available to 100%: All data available). The "Data Quality" (0%: Bad data quality to 100%: Best data quality) and the "Calculation Method" (0%: No standardized and/or established calculation method to 100%: Approved calculation method) are graded as well (Fig.3). The results of the uncertainties in the mentioned categories help classify and interpret the results. Additionally, the categorization indicates where the most data uncertainty exists and guides practitioners to gather better information during later project stages when more detailed data is available.

## **5 Summary**

Evonik has developed a standardized method, called Carbon Footprint Estimation (CFE), for the quantification of potential climate change impacts for projects in early stages of development. The CFE model allows a standardized evaluation of projects pertaining to their carbon emissions and savings and enables a better comparability of Evonik projects. It is especially useful as a reference method to determine the potential CO<sub>2eq</sub> impacts of projects in R&D departments. A full LCA which assesses more environmental impacts than merely climate change impacts is, however, essential for a precise calculation of emissions and a comparison of savings for projects in later stages. In this regard, the CFE model does not claim to replace an LCA; it is a pragmatic approach to estimate the carbon footprint of products or applications.